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PERMISSIBLE EXPLOSIVES

TESTED PRIOR TO JANUARY 1, 1914

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First edition. January, 1914.

PERMISSIBLE EXPLOSIVES TESTED PRIOR TO JANUARY 1, 1914.

By Clarence Hall.

GENERAL STATEMENT.

The following list contains the names of all explosives now considered to be permissible explosives that were tested by the Bureau of Mines prior to January 1, 1914.

The reader is referred to Miners' Circular 6 for information regarding the conditions under which permissible explosives are tested, the tests used by the Bureau of Mines for determining what explosives are to be included in the list, and the precautions to be observed in the handling, storage, and use of permissible explosives. Detailed descriptions of some of the tests and the apparatus used are given in Bulletin 15, "Investigations of Explosives Used in Coal Mines," and Bulletin 66, "Tests of Permissible Explosives," and the proper methods of storing, handling, and using permissible explosives are discussed in Bulletin 17, "A Primer on Explosives for Coal Miners," Bulletin 10, "The Use of Permissible Explosives," and Miners' Circular 7, "The Use and Misuse of Explosives in Coal Mining."

Persons who have received previous lists of permissible explosives will notice that certain explosives that were named in those lists are not included in the present list. Those explosives are omitted for the reason that they are no longer denominated permissible explosives. The present list takes the place of all preceding lists.

DEFINITION OF PERMISSIBLE EXPLOSIVE.

An explosive is called a permissible explosive when it is similar in all respects to the sample that passed certain tests by the United States Bureau of Mines, and when it is used in accordance with the conditions prescribed by this bureau.

But even the explosives that have passed those tests and are named in this list as permissible explosives are to be considered as permissible explosives only when used under the following conditions:

1. That the explosive is in all respects similar to the sample submitted by the manufacturer for test.

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2. That detonators—preferably electric detonators—are used of not less efficiency than those prescribed, namely, those consisting by weight of 90 parts of mercury fulminate and 10 parts of potassium chlorate (or their equivalents).

3. That the explosive, if frozen, shall be thoroughly thawed in a safe and suitable manner before use.

4. That the quantity used for a shot does not exceed 1½ pounds (680 grams), and that it is properly tamped with clay or other noncombustible stemming.

It must not be supposed that an explosive that has once passed the required tests and has been published in lists of permissible explosives is always thereafter to be considered a permissible explosive, regardless of its condition or the way in which it is used. Thus, for example, an explosive named in the permissible list, if kept in a moist place until it undergoes a change in character, is no longer to be considered a permissible explosive. If used in a frozen or partly frozen condition, it is not when so used a permissible explosive. If used in excess of the quantity specified (1½ pounds), it is not, when so used, a permissible explosive. And when the other conditions have been met, it is not a permissible explosive if fired with a detonator of less efficiency than that prescribed.

Moreover, even when all the prescribed conditions have been met, no permissible explosive should necessarily be considered as *permanently* being a permissible explosive, but any permissible explosive when used under the prescribed conditions may properly continue to be considered a permissible explosive until notice of its withdrawal or removal from the list has been officially published, or until its name is omitted from a later list published by the Bureau of Mines.

Furthermore, the manufacturers of a permissible explosive may withdraw it at any time when introducing a new explosive of superior qualities. And after further experiments and conferences the Bureau of Mines may find it advisable to adopt additional and more severe tests to which all permissible explosives may be subjected, in the hope that through the use of such explosives only as may pass the more severe tests, the lives of miners may be better safeguarded.

Subject to the conditions and provisions stated above, the following explosives are classed as permissible explosives:

TABLE I.—*Permissible explosives tested prior to January 1, 1914.*

Brand.	Class designation.	When used with detonators, preferably electric detonators of not less efficiency than—	Manufacturer.
Aetna coal powder A	Class 4	No. 6	Aetna Powder Co., Chicago, Ill.
Aetna coal powder AA	Class 1 *a*	do.	Do.
Aetna coal powder B	Class 4	do.	Do.
Aetna coal powder C	do.	do.	Do.
Bental coal powder No. 1-A	Class 1 *a*	do.	Independent Powder Co., Joplin, Mo.
Bental coal powder No. 2	do.	No. 7	Do.
Bental coal powder No. 2-X	do.	No. 6	Do.
Bituminite No. 1	Class 4	do.	Jefferson Powder Co., Birmingham, Ala.
Bituminite No. 3	do.	do.	Do.
Bituminite No. 4	do.	do.	Do.
Bituminite No. 5	Class 1 *a*	do.	Do.
Black Diamond No. 2-A	Class 4	do.	Illinois Powder Manufacturing Co., St. Louis, Mo.
Black Diamond No. 3-A	do.	do.	Do.
Black Diamond No. 5	Class 1 *a*	do.	Do.
Black Diamond No. 6-L. F.	Class 4	do.	Do.
Cameron mine powder No. 1-A.	Class 1 *a*	do.	Cameron Powder Manufacturing Co., Emporium, Pa.
Cameron mine powder No. 2-A.	do.	do.	Do.
Cameron mine powder No. 2-A, L. F.	do.	do.	Do.
Cameron mine powder No. 3-A.	Class 4	do.	Do.
Carbonite No. 1	do.	do.	E. I. du Pont de Nemours Powder Co., Wilmington, Del.
Carbonite No. 2	do.	do.	Do.
Carbonite No. 3	do.	do.	Do.
Carbonite No. 4	do.	do.	Do.
Carbonite No. 5	do.	do.	Do.
Carbonite No. 6	do.	do.	Do.
Coalite A[1]	Class 1 *a*	do.	Atlas Powder Co., Wilmington, Del.
Coalite X[1]	do.	do.	Do.
Coalite No. 1[1]	Class 4	do.	Do.
Coalite No. 2-D[1]	do.	do.	Do.
Coalite No. 2-D. L[1]	do.	do.	Do.
Coalite No. 2-M, L. F.[1]	do.	do.	Do.
Coalite No. 3-X[1]	Class 1 *a*	do.	Do.
Coalite No. 3XA[1]	do.	do.	Do.
Coalite No. 3-XB[1]	do.	do.	Do.
Coalite No. 3-XC[1]	do.	do.	Do.
Coal special No. 1	Class 4	do.	Keystone National Powder Co., Emporium, Pa.
Coal special No. 2	do.	do.	Do.
Coal special No. 2-W	do.	do.	Do.
Coal special No. 3-C	do.	do.	Do.
Collier powder B, N. F	Class 1 *a*	do.	Do.
Collier powder KN	do.	do.	Do.
Collier powder No. X	do.	do.	Do.
Collier powder X, L. F	do.	do.	Do.
Collier powder No. 2	Class 4	do.	Do.
Collier powder No. 5	Class 1 *a*	do.	Do.

[1] Manufacture by Atlas Powder Co. authorized under date of October 16, 1913.

TABLE I.—*Permissible explosives tested prior to January 1, 1914*—Continued.

Brand.	Class designation.	When used with detonators, preferably electric detonators of not less efficiency than—	Manufacturer.
Collier powder No. 5–L. F.	Class 1 *a*	No. 6	Keystone National Powder Co., Emporium, Pa.
Collier powder No. 5 special	...do	...do	Do.
Collier powder No. 6–L. F.	Class 4	...do	Do.
Collier No. 9	Class 1 *a*	...do	Do.
Collier powder No. 11	...do	...do	Do.
Cronite No. 1	...do	...do	G. R. McAbee Powder & Oil Co., Pittsburgh, Pa.
Cronite No. 5	...do	No. 7	Do.
Detonite special	...do	...do	The King Powder Co., Cincinnati, Ohio.
Eureka No. 2	Class 2	No. 6	G. R. McAbee Powder & Oil Co., Pittsburgh, Pa.
Fort Pitt mine powder No. 1	Class 4	...do	Fort Pitt Powder Co., Pittsburgh, Pa.
Fuel-ite No. 1	...do	...do	Burton Powder Co., Pittsburgh, Pa.
Fuel-ite No. 2	...do	...do	Do.
Fuel-ite No. 3	Class 1 *a*	...do	Do.
Giant A low-flame dynamite.	Class 2	...do	Giant Powder Co. (Consolidated), Giant, Cal.
Giant B low-flame dynamite.	...do	...do	Do.
Giant C low-flame dynamite.	...do	...do	Do.
Giant coal-mine powder No. 5.	Class 1 *a*	...do	Do.
Giant coal-mine powder No. 6.	Class 2	...do	Do.
Giant coal-mine powder No. 7.	...do	...do	Do.
Giant coal-mine powder No. 8.	...do	...do	Do.
Guardian A	Class 4	No. 7	Independent Powder Co., Joplin, Mo.
Guardian No. 2	Class 1 *a*	No. 6	Do.
Guardian No. 2–X	...do	...do	Do.
Guardian No. 3	...do	...do	Do.
Guardian No. 3–X	...do	...do	Do.
Guardian coal powder B	Class 4	No. 7	Do.
Hecla No. 2	Class 1 *a*	...do	E. I. du Pont de Nemours Powder Co., Wilmington, Del.
Kanite A	Class 1 *b*	No. 8	W. H. Blumenstein Chemical Works, Pottsville, Pa.
Lomite No. 1	Class 2	No. 6	G. R. McAbee Powder & Oil Co., Pittsburgh, Pa.
Lowinite No. 2–B	Class 1 *a*	...do	Lowite Explosives Manufacturing Co., Pittsburgh, Pa.
Meteor AXXO	Class 2	...do	E. I. du Pont de Nemours Powder Co., Wilmington, Del.
Mine-ite A	Class 4	...do	Burton Powder Co., Pittsburgh, Pa.
Mine-ite A–2	...do	...do	Do.
Mine-ite B	...do	...do	Do.

TABLE I.—*Permissible explosives tested prior to January 1, 1914*—Continued.

Brand.	Class designation.	When used with detonators, preferably electric detonators of not less efficiency than—	Manufacturer.
Mine-ite B–2	Class 4	No. 6	Burton Powder Co., Pittsburgh, Pa.
Mine-ite No. 5–D	Class 1 *a*	do	Do.
Monobel No. 1	do	do	E. I. du Pont de Nemours Powder Co., Wilmington, Del.
Monobel No. 2	do	do	Do.
Monobel No. 3	do	do	Do.
Monobel No. 4	do	do	Do.
Monobel No. 5	do	do	Do.
Monobel No. 6	do	do	Do.
Monobel No. 7	do	do	Do.
Nitro low-flame No. 1	Class 4	do	Nitro Powder Co., Kingston, N. Y.
Nitro low-flame No. 2	do	do	Do.
Red H No. 1 [1]	Class 1 *a*	do	Hercules Powder Co., Wilmington, Del.
Red H No. 2 [1]	do	do	Do.
Red H No. 3 [1]	do	do	Do.
Red H No. 4 [1]	do	do	Do.
Red H No. 5 [1]	do	do	Do.
Red H No. 6 [1]	do	do	Do.
Red H No. 7 [1]	do	do	Do.
Trojan coal powder H	Class 3	do	Pennsylvania Trojan Powder Co., Allentown, Pa.
Trojan coal powder I	do	do	Do.
Trojan coal powder J	do	do	Do.
Tunnelite B	Class 1 *a*	do	G. R. McAbee Powder & Oil Co., Pittsburgh, Pa.
Tunnelite C	do	do	Do.
Tunnelite No. 5	Class 4	do	Do.
Tunnelite No. 6	do	do	Do.
Tunnelite No. 6–L. F	do	do	Do.
Tunnelite No. 7	do	do	Do.
Tunnelite No. 8	do	do	Do.
Tunnelite No. 8–L. F	do	do	Do.
Vigorite No. 1 [2]	do	do	Atlas Powder Co., Wilmington, Del.
Vigorite No. 6 [2]	do	do	Do.
Xpdite No. 1 [3]	do	do	Hercules Powder Co., Wilmington, Del.
Xpdite No. 2 [3]	do	do	Do.
Xpdite No. 3 [4]	do	do	Do.
Xpdite No. 4 [3]	do	do	Do.
Xpdite No. 5 [3]	do	do	Do.
Xpdite No. 6 [3]	do	do	Do.

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[1] Correspond to the respective grades of Monobel as manufactured by the E. I. du Pont de Nemours Powder Co. Authorized under date of October 16, 1913.

[2] Correspond to the respective grades of Carbonite as manufactured by the E. I. du Pont de Nemours Powder Co. Authorized under date of October 16, 1913.

[3] Correspond to the respective grades of Carbonite as manufactured by the E. I. du Pont de Nemours Powder Co. Authorized under date of July 18, 1913.

[4] Corresponds to the respective grade of Carbonite as manufactured by the E. I. du Pont de Nemours Powder Co. Authorized under date of August 6, 1913.

CLASSES OF PERMISSIBLE EXPLOSIVES.

In order that a user of explosives may know the nature and the characteristic component of each of the permissible explosives, and that he may be able to select an explosive to meet a specific requirement, Table 2 has been prepared. In this table the explosives are arranged in four classes, based on the properties of the characteristic ingredient, and the rate of detonation of each explosive is given.

TABLE 2.—*Classes and rate of detonation of permissible explosives.*

Class and brand of explosive.	Rate of detonation in 1¼ by 8 inch cartridge.	
	Feet per second.	Meters per second.
CLASS 1. AMMONIUM NITRATE.		
SUBCLASS *a*.		
Aetna coal powder AA	7,880	2,403
Bental coal powder No. 1–A	7,690	2,343
Bental coal powder No. 2	4,750	1,447
Bental coal powder No. 2–X	7,980	2,432
Bituminite No. 5	9,120	2,782
Black Diamond No. 5	6,020	1,835
Black Diamond No. 6–L. F.	9,630	2,935
Cameron mine powder No. 1–A	10,950	3,339
Cameron mine powder No. 2–A	10,520	[a] 3,206
Cameron mine powder No. 2–A, L. F.	10,950	3,338
Coalite A	8,870	2,705
Coalite X	9,000	2,745
Coalite No. 3–X	7,290	2,223
Coalite No. 3–XA	10,420	3,176
Coalite No. 3–XB	11,290	3,441
Coalite No. 3–XC	8,320	2,536
Collier powder B, N. F.	10,950	3,338
Collier powder KN	11,610	3,539
Collier powder No. X	7,820	2,384
Collier powder X, L. F.	9,990	3,047
Collier powder No. 5	8,280	2,524
Collier powder No. 5–L. F.	9,370	2,858
Collier powder No. 5, special	8,330	2,541
Collier No. 9	6,690	2,040
Collier powder No. 11	11,680	3,561
Cronite No. 1	10,490	3,198
Cronite No. 5	8,090	2,466
Detonite special	10,840	[b] 3,305
Fuel-ite No. 3	8,590	2,620
Giant coal-mine powder No. 5	10,230	3,118
Guardian No. 2	8,980	2,738
Guardian No. 2–X	7,990	2,437
Guardian No. 3	7,660	2,336
Guardian No. 3–X	8,470	2,582
Hecla No. 2	13,990	4,264
Lowinite No. 2–B	9,740	2,971
Mine-ite No. 5–D	8,720	2,658
Monobel No. 1	11,700	3,568
Monobel No. 2	9,870	3,009
Monobel No. 3	7,260	2,212
Monobel No. 4	8,980	2,738
Monobel No. 5	6,760	2,061

[a] 1½-inch cartridges used.

[b] 1¾-inch cartridges used.

TABLE 2.—*Classes and rate of detonation of permissible explosives*—Continued.

Class and brand of explosive.	Rate of detonation in 1¼ by 8 inch cartridge.	
	Feet per second.	Meters per second.
CLASS 1. AMMONIUM NITRATE—Continued.		
SUBCLASS *a*—continued.		
Monobel No. 6	10,380	3,165
Monobel No. 7	10,050	3,065
Red H No. 1	11,700	3,568
Red H No. 2	9,870	3,009
Red H No. 3	7,260	2,212
Red H No. 4	8,980	2,738
Red H No. 5	6,760	2,061
Red H No. 6	10,380	3,165
Red H No. 7	10,050	3,065
Tunnelite B	9,990	3,047
Tunnelite C	10,060	3,068
SUBCLASS *b*.		
Kanite A	10,730	[a] 3,270
CLASS 2. HYDRATED.		
Eureka No. 2	10,720	3,269
Giant A low-flame dynamite	8,140	2,481
Giant B low-flame dynamite	9,100	2,773
Giant C low-flame dynamite	8,860	2,702
Giant coal-mine powder No. 6	11,540	3,519
Giant coal-mine powder No. 7	10,830	3,301
Giant coal-mine powder No. 8	10,830	3,301
Lomite No. 1	13,940	4,250
Meteor AXXO	8,410	2,563
CLASS 3. ORGANIC NITRATE (OTHER THAN NITROGLYCERIN).		
Trojan coal powder H	9,420	2,872
Trojan coal powder I	9,620	2,934
Trojan coal powder J	10,590	3,230
CLASS 4. NITROGLYCERIN.		
Aetna coal powder A	12,620	3,848
Aetna coal powder B	9,870	3,008
Aetna coal powder C	7,010	2,138
Bituminite No. 1	12,800	3,901
Bituminite No. 3	9,330	2,843
Bituminite No. 4	7,540	2,298
Black Diamond No. 2-A	12,600	3,842
Black Diamond No. 3-A	11,160	3,402
Cameron mine powder No. 3-A	10,930	3,333
Carbonite No. 1	10,950	3,338
Carbonite No. 2	11,380	3,470
Carbonite No. 3	8,710	2,656
Carbonite No. 4	7,670	2,339
Carbonite No. 5	10,140	3,092
Carbonite No. 6	7,490	2,285
Coalite No. 1	7,930	2,418
Coalite No. 2-D	8,430	2,571

[a] 1¾-inch cartridges used.

TABLE 2.—*Classes and rate of detonation of permissible explosives*—Continued.

Class and brand of explosive.	Rate of detonation in 1¼ by 8 inch cartridge.	
	Feet per second.	Meters per second.
CLASS 4. NITROGLYCERIN—Continued.		
Coalite No. 2–D. L	7,340	2,237
Coalite No. 2–M, L. F	9,220	2,811
Coal special No. 1	11,800	3,598
Coal special No. 2	10,240	3,123
Coal special No. 2–W	11,590	3,534
Coal special No. 3–C	9,760	2,977
Collier powder No. 2	8,870	2,704
Collier powder No. 6–L. F	9,660	2,944
Fort Pitt mine powder No. 1	11,230	3,424
Fuel-ite No. 1	11,150	3,400
Fuel-ite No. 2	8,240	2,512
Guardian A	10,130	3,089
Guardian coal powder B	8,960	2,733
Mine-ite A	11,290	3,443
Mine-ite A–2	10,670	3,252
Mine-ite B	9,540	2,908
Mine-ite B–2	7,410	2,260
Nitro low-flame No. 1	13,380	4,079
Nitro low-flame No. 2	14,560	4,439
Tunnelite No. 5	8,400	2,562
Tunnelite No. 6	9,670	2,947
Tunnelite No. 6–L. F	9,620	2,933
Tunnelite No. 7	8,720	2,659
Tunnelite No. 8	8,020	2,446
Tunnelite No. 8–L. F	8,720	2,658
Vigorite No. 1	10,950	3,338
Vigorite No. 6	7,490	2,285
Xpdite No. 1	10,950	3,338
Xpdite No. 2	11,380	3,470
Xpdite No. 3	8,710	2,656
Xpdite No. 4	7,670	2,339
Xpdite No. 5	10,140	3,092
Xpdite No. 6	7,490	2,285

Tables 1 and 2 include all the permissible explosives that have passed the required tests prior to January 1, 1914. The announcement of the passing of the required tests by other explosives will be made public after the completion of the tests.

Approved January 3, 1914.

JOSEPH A. HOLMES, *Director.*

PUBLICATIONS ON MINE ACCIDENTS AND TESTS OF EXPLOSIVES.

The following Bureau of Mines publications may be obtained free by applying to the Director, Bureau of Mines, Washington, D. C.:

BULLETIN 10. The use of permissible explosives, by J. J. Rutledge and Clarence Hall. 1912. 34 pp., 5 pls.

BULLETIN 15. Investigations of explosives used in coal mines, by Clarence Hall, W. O. Snelling, and S. P. Howell, with a chapter on the natural gas used at Pittsburgh, by G. A. Burrell, and an introduction by C. E. Munroe. 1911. 197 pp., 7 pls.

BULLETIN 17. A primer on explosives for coal miners, by C. E. Munroe and Clarence Hall. 61 pp., 10 pls. Reprint of United States Geological Survey Bulletin 423.

BULLETIN 20. The explosibility of coal dust, by G. S. Rice, with chapters by J. C. W. Frazer, Axel Larsen, Frank Haas, and Carl Scholz. 204 pp., 14 pls. Reprint of United States Geological Survey Bulletin 425.

BULLETIN 44. First national mine-safety demonstration, by H. M. Wilson and A. H. Fay, with a chapter on the explosion at the experimental mine, by G. S. Rice. 1912. 75 pp., 7 pls.

BULLETIN 46. An investigation of explosion-proof mine motors, by H. H. Clark. 1912. 44 pp., 6 pls.

BULLETIN 48. The selection of explosives used in engineering and mining operations, by Clarence Hall and S. P. Howell. 1913. 50 pp., 3 pls.

BULLETIN 51. The analysis of black powder and dynamite, by W. O. Snelling and C. G. Storm. 1913. 80 pp., 5 pls., 5 figs.

BULLETIN 52. Ignition of mine gases by the filaments of incandescent lamps, by H. H. Clark and L. C. Ilsley. 1913. 31 pp., 6 pls.

BULLETIN 59. Investigations of detonators and electric detonators, by Clarence Hall and S. P. Howell. 1913. 73 pp., 7 pls., 5 figs.

BULLETIN 66. Tests of permissible explosives, by Clarence Hall and S. P. Howell. 1913. 313 pp., 1 pl., 6 figs.

BULLETIN 69. Coal-mine accidents in the United States and foreign countries, compiled by F. W. Horton. 1913. 98 pp., 3 pls., 40 figs.

TECHNICAL PAPER 4. The electrical section of the Bureau of Mines, its purpose and equipment, by H. H. Clark. 1911. 12 pp.

TECHNICAL PAPER 6. The rate of burning of fuse as influenced by temperature and pressure, by W. O. Snelling and W. C. Cope. 1912. 28 pp.

TECHNICAL PAPER 7. Investigations of fuse and miners' squibs, by Clarence Hall and S. P. Howell. 1912. 19 pp.

TECHNICAL PAPER 11. The use of mice and birds for detecting carbon monoxide after mine fires and explosions, by G. A. Burrell. 1912. 15 pp.

TECHNICAL PAPER 12. The behavior of nitroglycerin when heated, by W. O. Snelling and C. G. Storm. 1912. 144 pp., 1 pl.

TECHNICAL PAPER 13. Gas analysis as an aid in fighting mine fires, by G. A. Burrell and F. M. Seibert. 1912. 16 pp.

TECHNICAL PAPER 17. The effect of stemming on the efficiency of explosives, by W. O. Snelling and Clarence Hall. 1912. 20 pp.

TECHNICAL PAPER 18. Magazines and thaw houses for explosives, by Clarence Hall and S. P. Howell. 1912. 34 pp., 1 pl.

TECHNICAL PAPER 19. The factor of safety in mine electrical installations, by H. H. Clark. 1912. 14 pp.

TECHNICAL PAPER 21. The prevention of mine explosions; report and recommendations, by Victor Watteyne, Carl Meisener, and Arthur Desborough. 12 pp. Reprint of United States Geological Survey Bulletin 369.

TECHNICAL PAPER 23. Ignition of mine gas by miniature electric lamps, by H. H. Clark. 1912. 5 pp.

TECHNICAL PAPER 24. Mine fires; a preliminary study, by G. S. Rice. 1912. 51 pp.

TECHNICAL PAPER 28. Ignition of mine gas by standard incandescent lamps, by H. H. Clark. 1912. 6 pp.

TECHNICAL PAPER 29. Training with mine-rescue breathing apparatus, by J. W. Paul. 1912. 16 pp.

TECHNICAL PAPER 30. Mine-accident prevention at Lake Superior iron mines, by D. E. Woodbridge. 1913. 38 pp., 9 figs.

TECHNICAL PAPER 40. Metal-mine accidents in the United States during the calendar year 1911, compiled by A. H. Fay. 1913. 54 pp.

TECHNICAL PAPER 43. The influence of inert gases on inflammable gaseous mixtures, by J. H. Clement. 1913. 24 pp., 1 pl., 8 figs.

TECHNICAL PAPER 46. Quarry accidents in the United States during the calendar year 1911, compiled by A. H. Fay. 1913. 32 pp.

TECHNICAL PAPER 48. Coal-mine accidents in the United States, 1896–1912, with monthly statistics for 1912, compiled by F. W. Horton. 1913. 74 pp.

TECHNICAL PAPER 52. Permissible explosives tested prior to March 1, 1913, by Clarence Hall. 1913. 11 pp.

TECHNICAL PAPER 61. Metal-mine accidents in the United States during the calendar year 1912, compiled by A. H. Fay. 1913. 76 pp., 1 fig.

MINERS' CIRCULAR 3. Coal-dust explosions, by G. S. Rice. 1911. 22 pp.

MINERS' CIRCULAR 4. The use and care of mine-rescue breathing apparatus, by J. W. Paul. 1911. 24 pp.

MINERS' CIRCULAR 5. Electrical accidents in mines; their causes and prevention, by H. H. Clark, W. D. Roberts, L. C. Ilsley, and H. F. Randolph. 1911. 10 pp., 3 pls.

MINERS' CIRCULAR 6. Permissible explosives tested prior to January 1, 1912, and precautions to be taken in their use, by Clarence Hall. 1912. 20 pp.

MINERS' CIRCULAR 7. The use and misuse of explosives in coal mining, by J. J. Rutledge. 1913. 52 pp., 8 figs.

MINERS' CIRCULAR 9. Accidents from falls of roof and coal, by G. S. Rice. 1912. 16 pp.

MINERS' CIRCULAR 10. Mine fires and how to fight them, by J. W. Paul. 1912. 14 pp.

MINERS' CIRCULAR 11. Accidents from mine cars and locomotives, by L. M. Jones. 1912. 16 pp.

MINERS' CIRCULAR 12. The use and care of miners' safety lamps, by J. W. Paul. 1913. 16 pp., 4 figs.

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